US008097326B2

(12) **United States Patent**
Wunderlich

(10) **Patent No.: US 8,097,326 B2**
(45) **Date of Patent: Jan. 17, 2012**

(54) **STACK COMPRISING MULTI-FOLDED FOUR PANEL SHEETS AND FOLDING BOARDS THEREFOR**

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(73) Assignee: **Paper Converting Machine Company**, Green Bay, WI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 452 days.

(21) Appl. No.: **12/258,639**

(22) Filed: **Oct. 27, 2008**

(65) **Prior Publication Data**

US 2010/0104799 A1 Apr. 29, 2010

(51) **Int. Cl.**
B32B 3/04 (2006.01)

(52) **U.S. Cl.** **428/126**; 428/130

(58) **Field of Classification Search** 428/126, 428/130; 221/48; 206/494

See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — Greer, Burns & Crain, Ltd.

(57) **ABSTRACT**

A stack of folded sheets comprises first and second groups of folded sheets. Each of the sheets if each group includes a center panel, it second panel, and a V-shaped portion including third and fourth panels. The sheets of the two groups are alternately arranged so that the second panel of each sheet of each group is adjacent a fourth panel of a sheet of the other group. The adjacent second and fourth panels may or may not be interleaved.

Adjustable folding boards are provided for folding elongated webs into the first and second folded sheets. Each of the folding boards includes a slidably mounted first plate which folds the fourth panel of the folded sheet. A second plate extends downwardly from the first plate and is also slidably mounted for movement transversely to the web. Third and fourth plates are mounted in front of the second plate.

Adjusting the first and second plates relative to the web changes the width of the fourth panel. Adjusting the third panel relative to the web changes the widths of the central panel and the third panel. Adjusting the fourth plate relative to the web changes the widths of the central panel and the second panel.

19 Claims, 13 Drawing Sheets

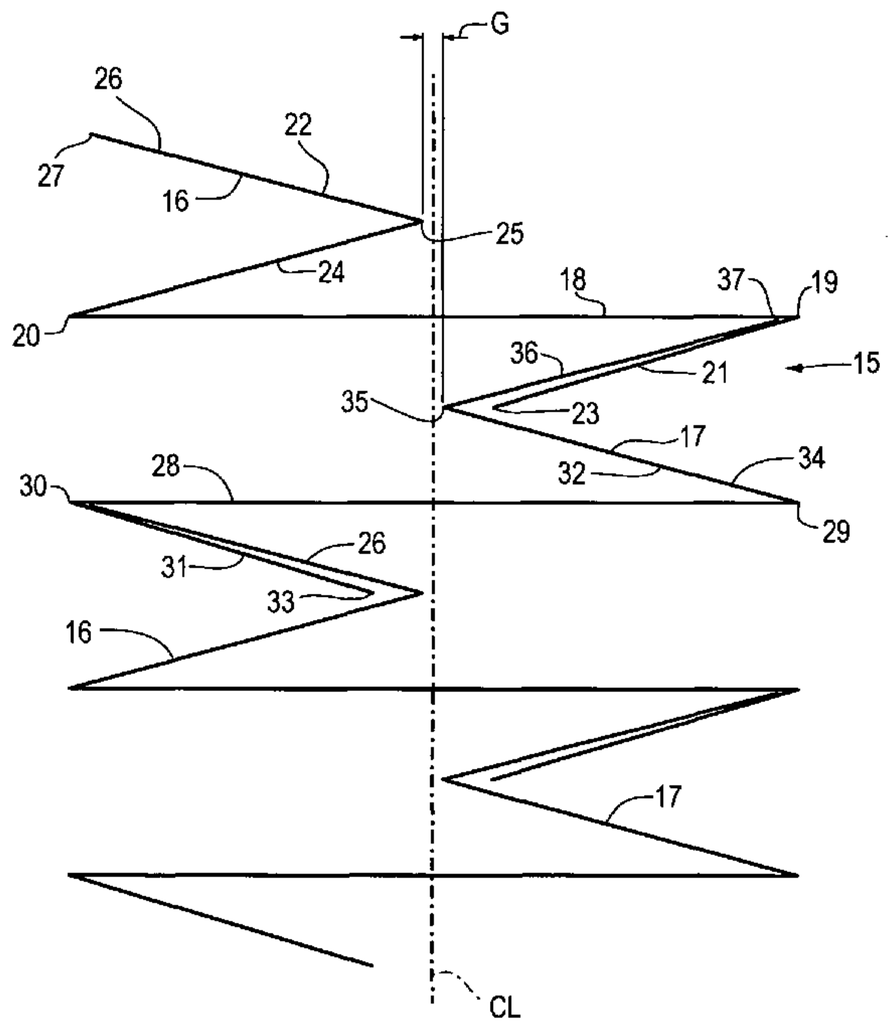


Fig. 1

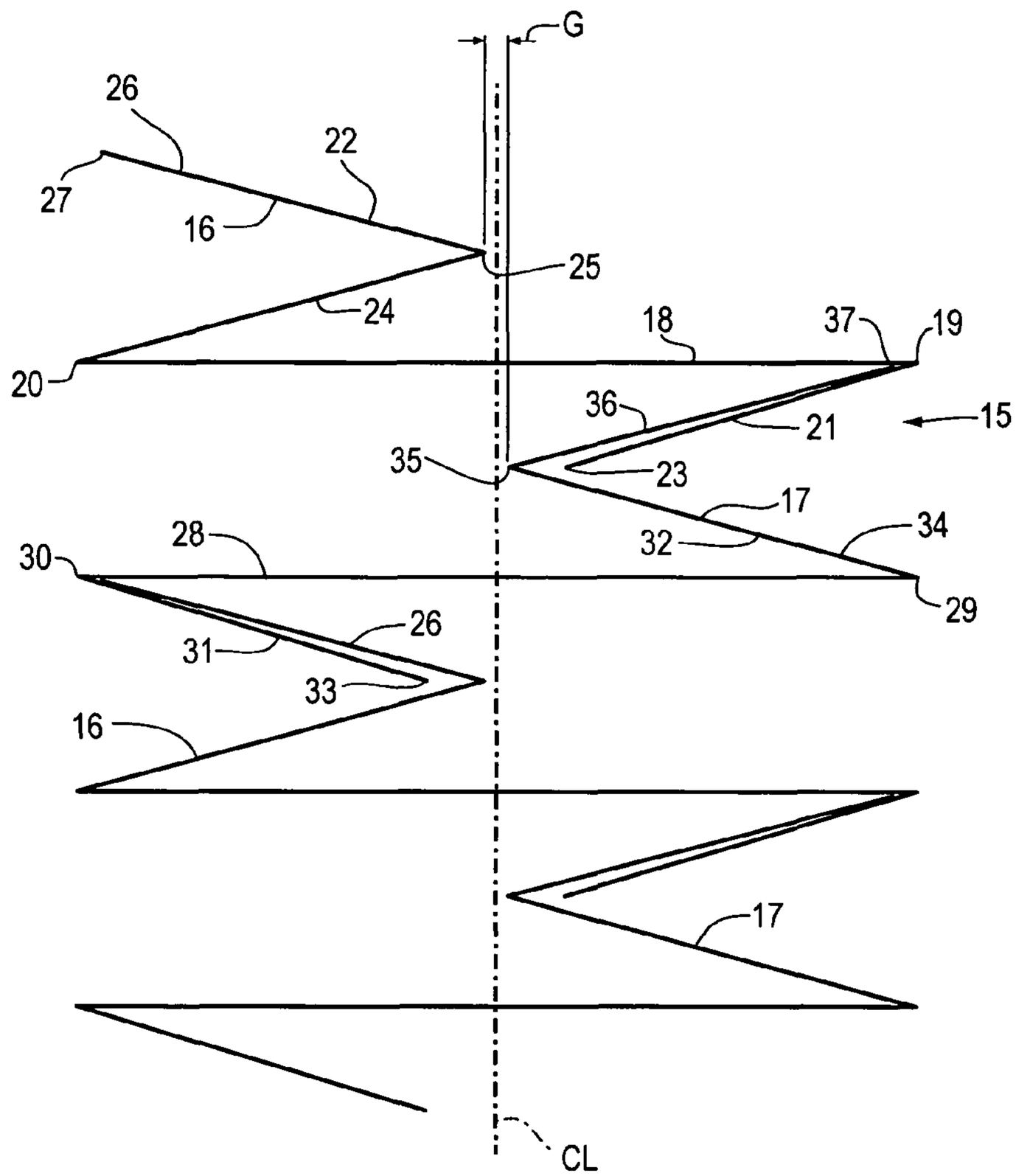

G
26
27
22
16
25
24
18
37
19
20
36
21
15
35
23
17
34
32
28
30
29
26
31
33
16
17
CL

Fig. 2

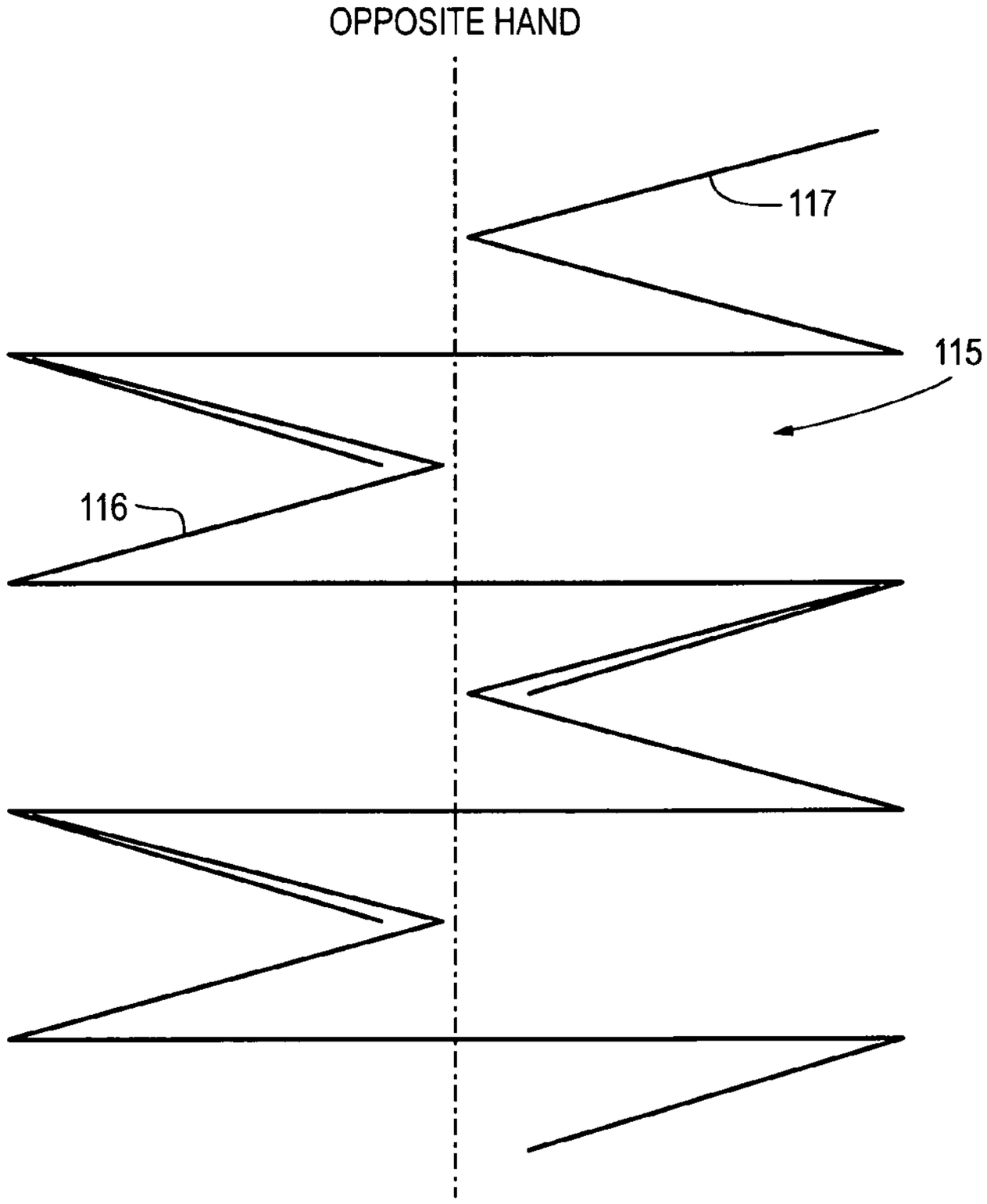


Fig. 3

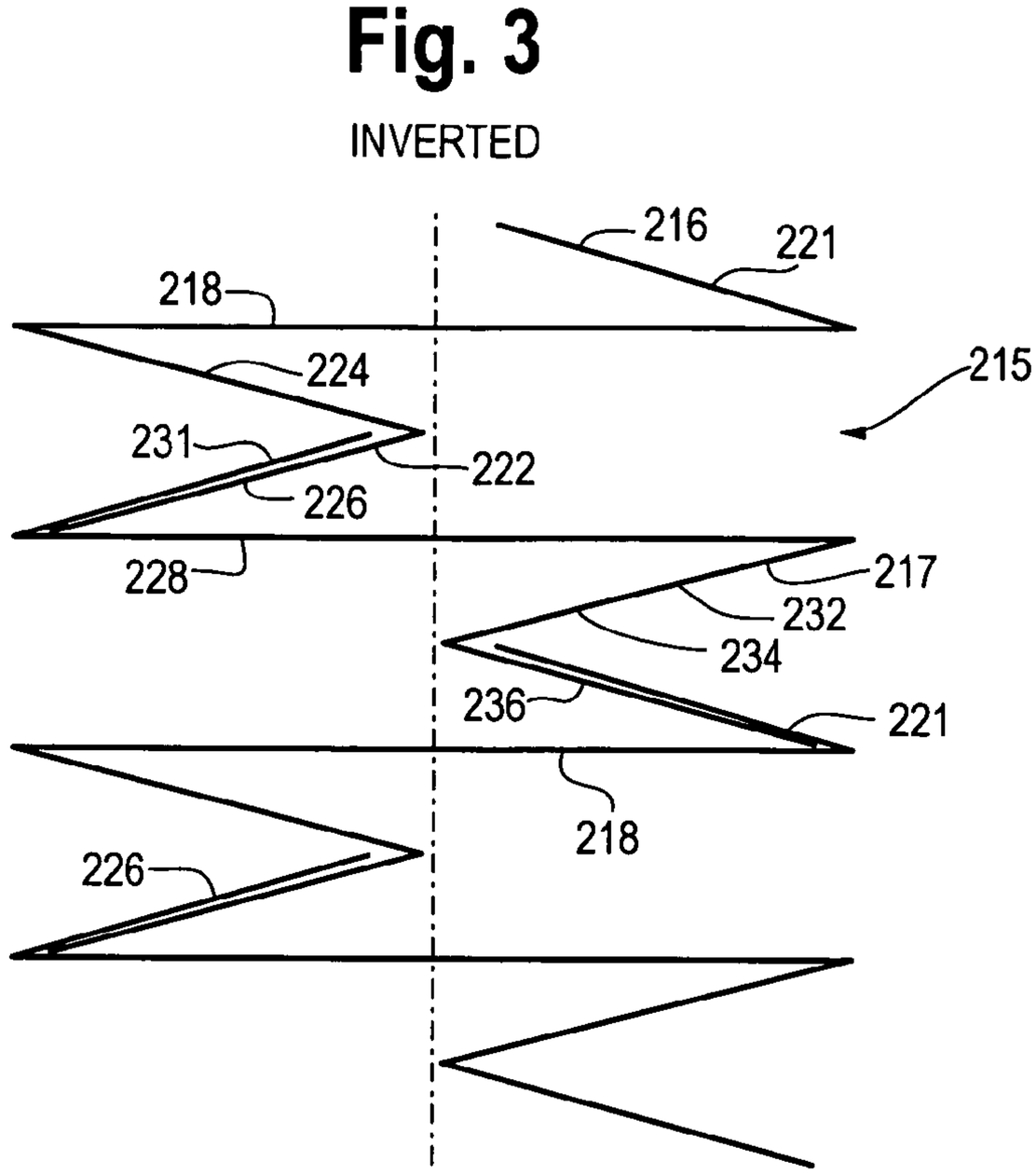

INVERTED
216
221
218
224
215
231
222
226
228
217
232
234
236
221
218
226

Fig. 4

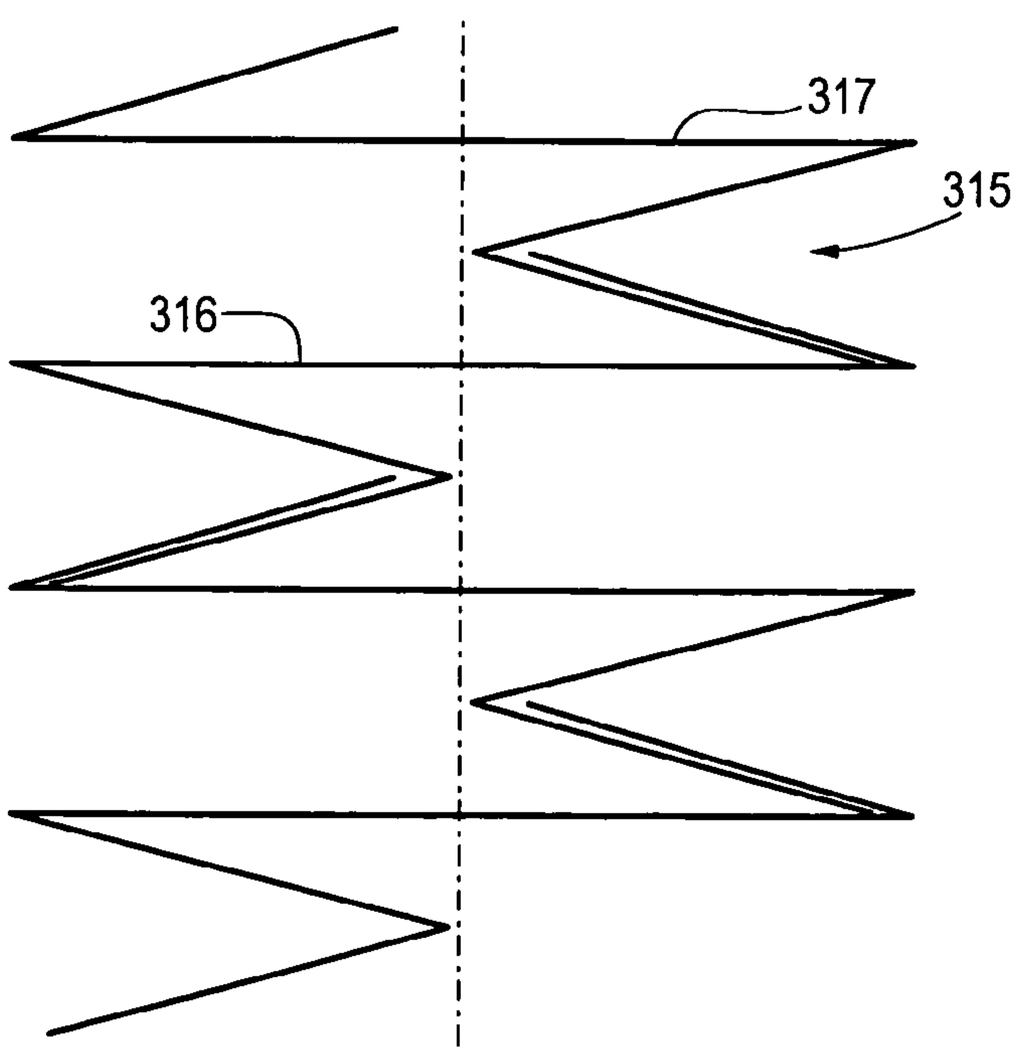

INVERTED OPPOSITE HAND
317
315
316

Fig. 5

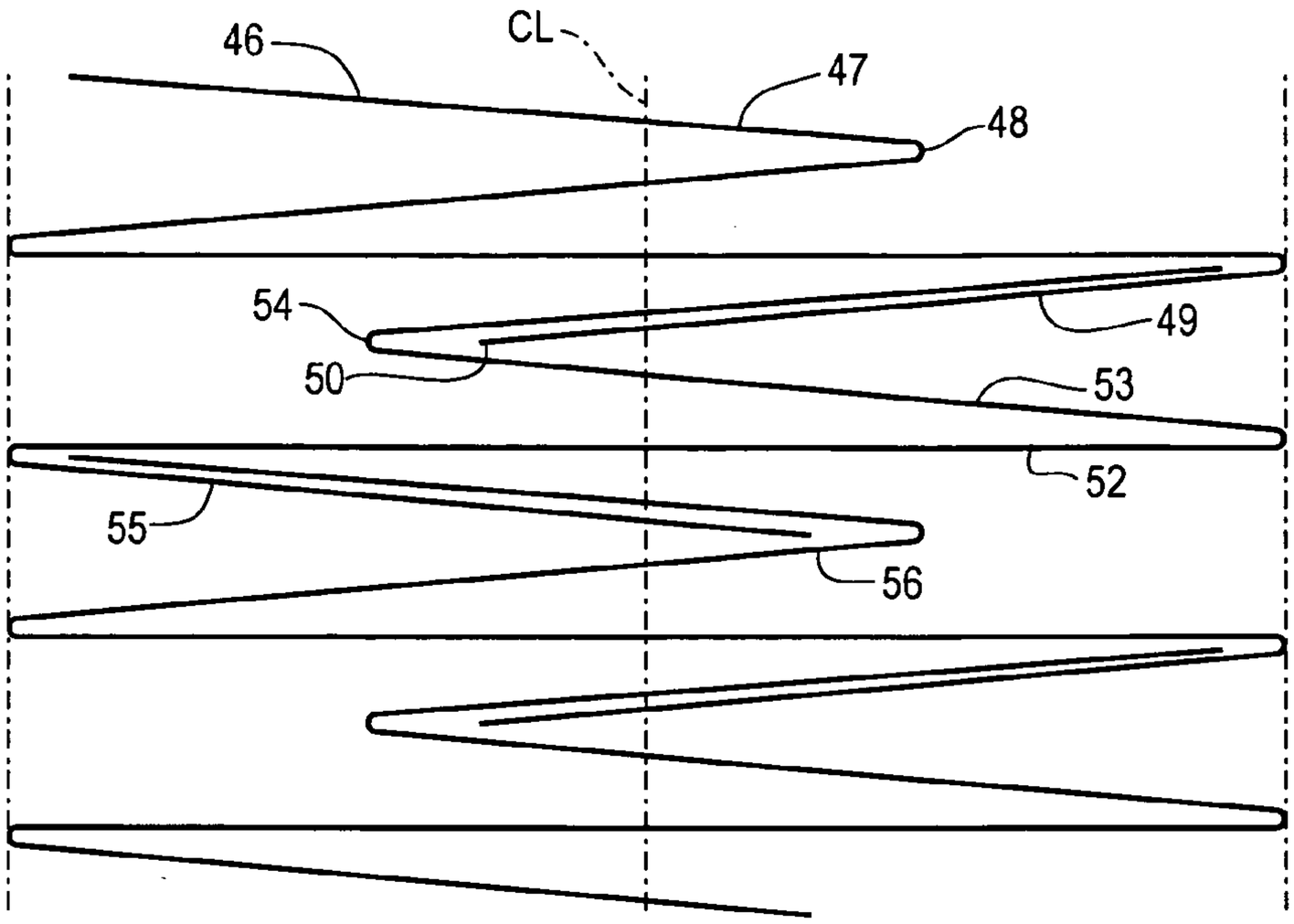


Fig. 6

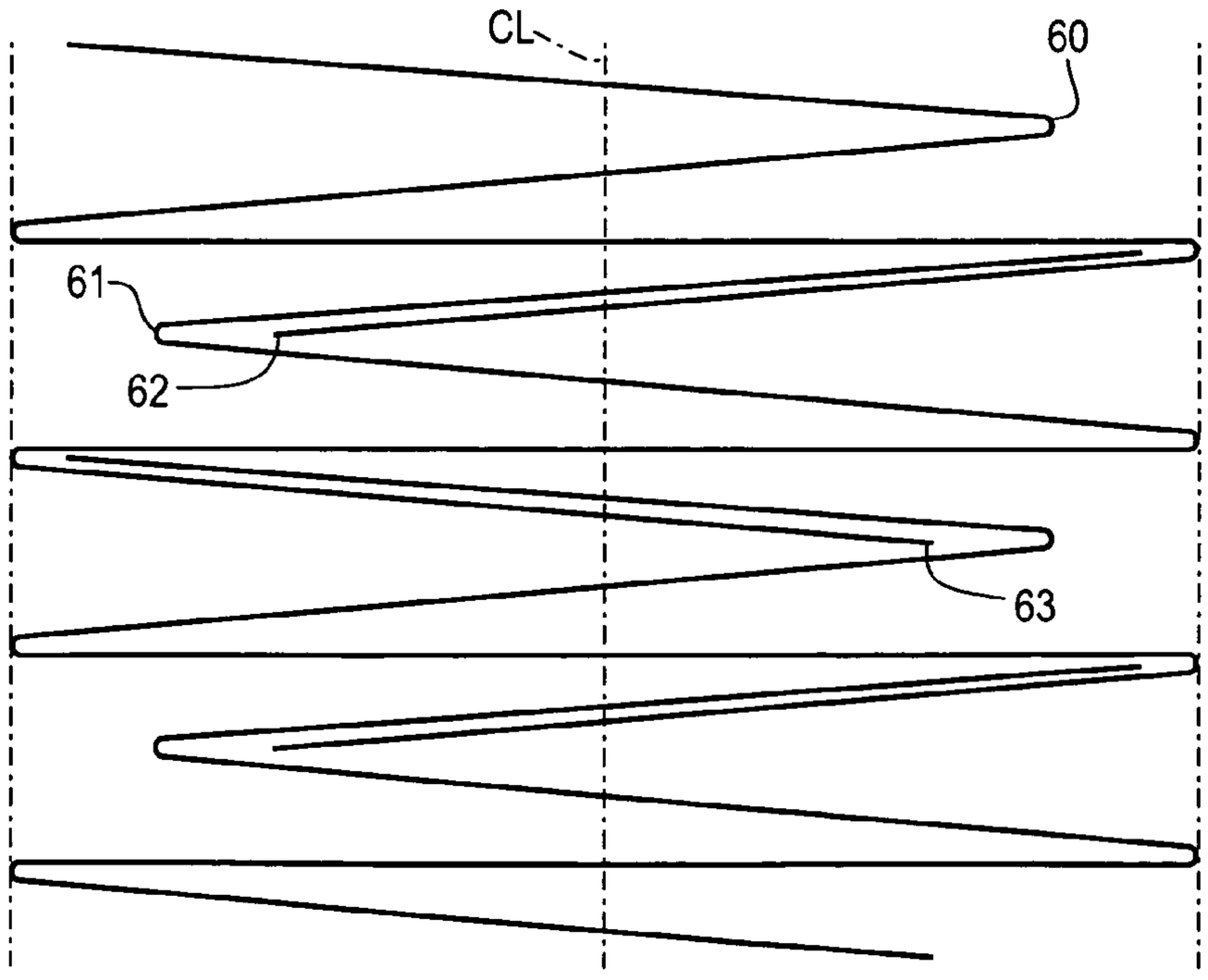


Fig. 7

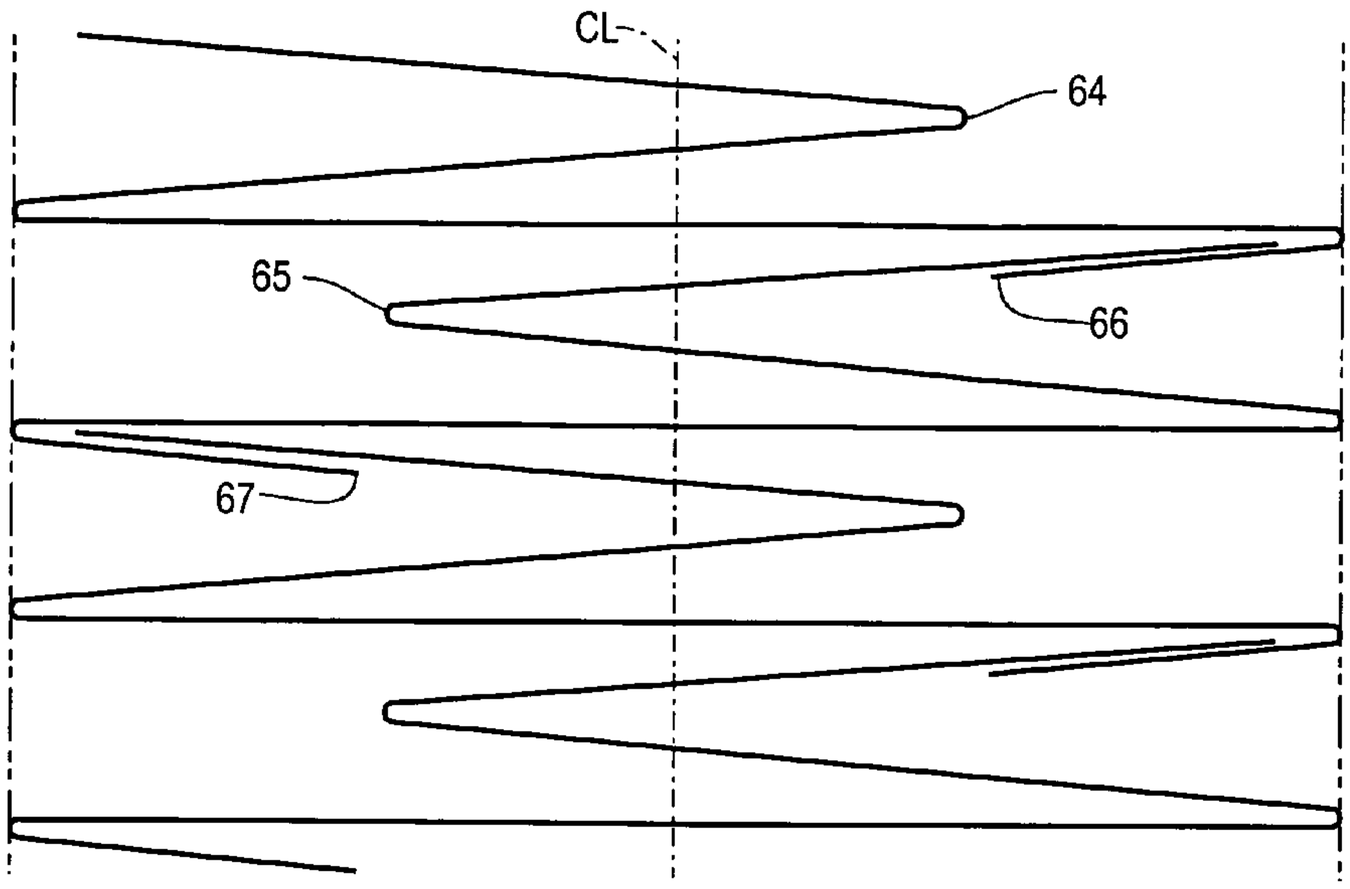

CL
64
65
66
67

Fig. 8

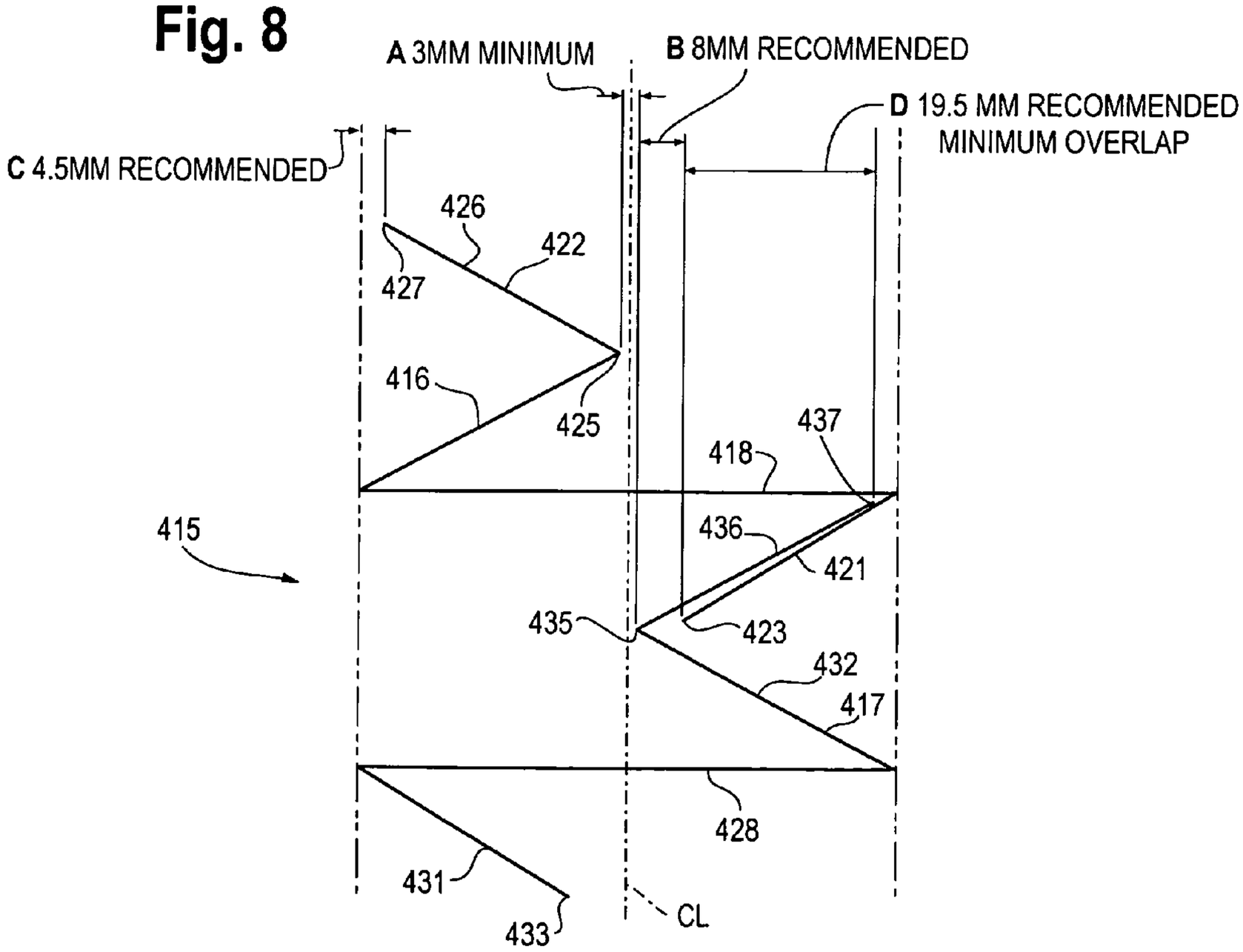

A 3MM MINIMUM
B 8MM RECOMMENDED
D 19.5 MM RECOMMENDED MINIMUM OVERLAP
C 4.5MM RECOMMENDED
426
422
427
416
425
437
418
436
421
435
423
432
417
428
431
433
415
CL

Fig. 9

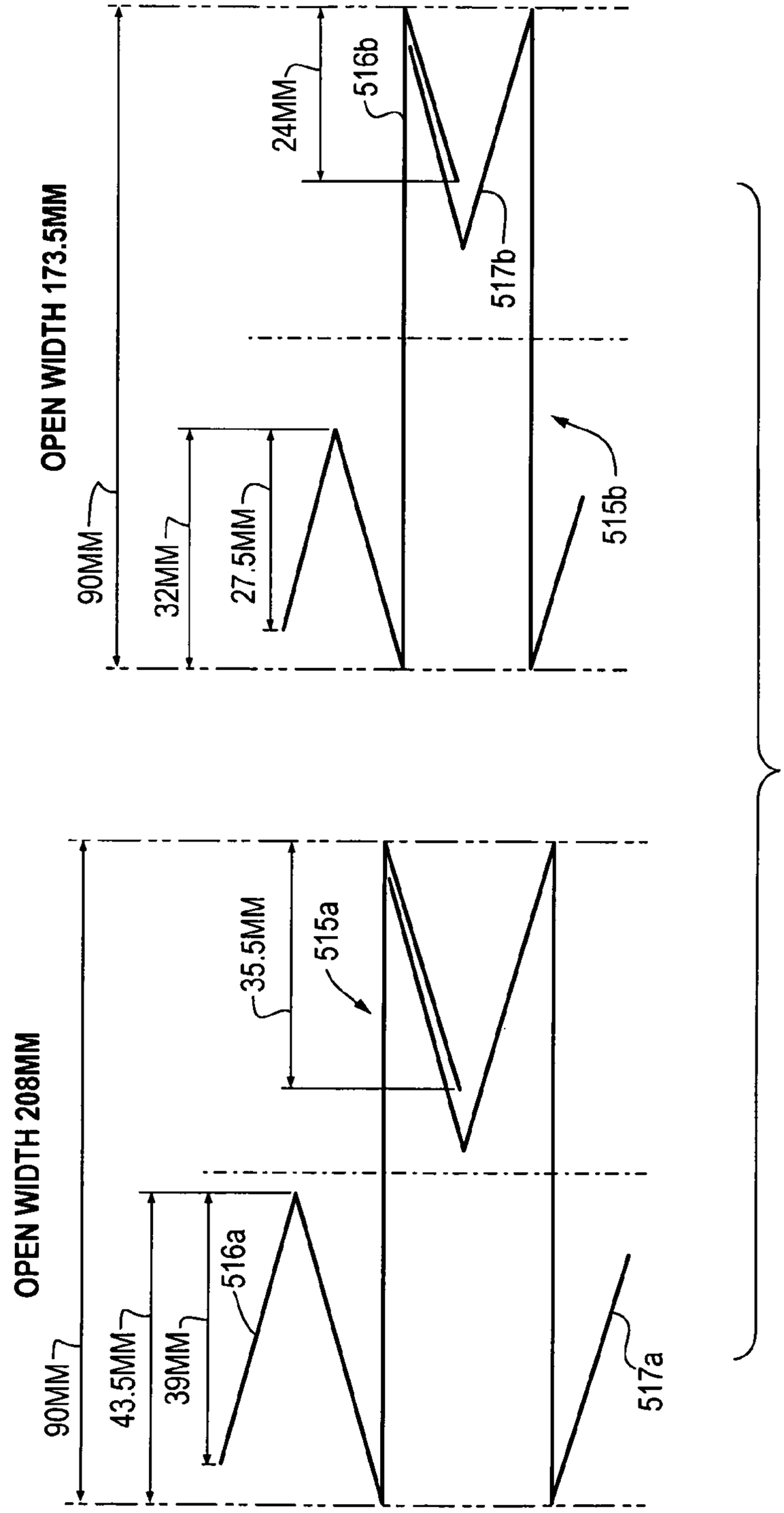
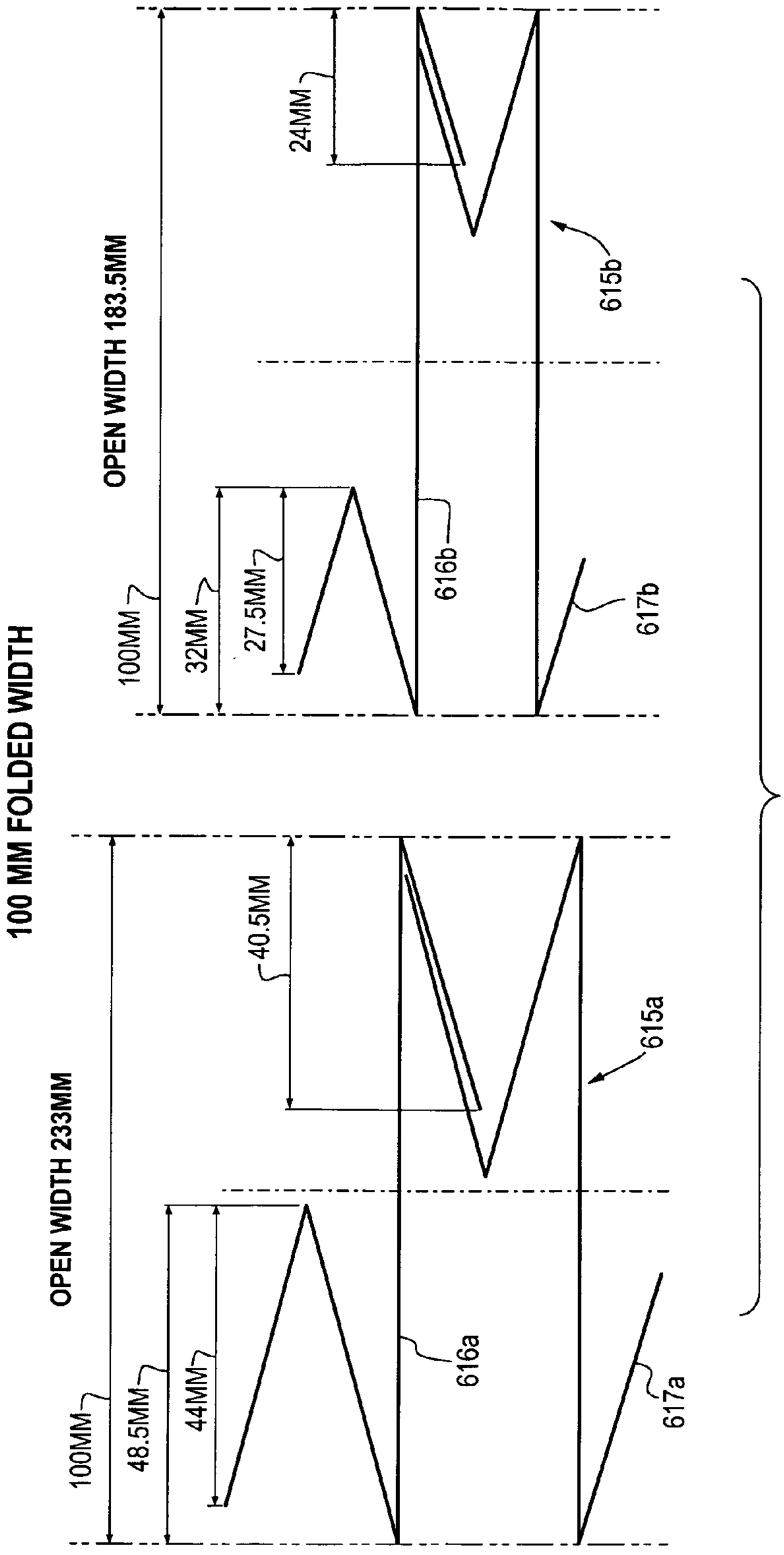

90 MM FOLDED WIDTH
OPEN WIDTH 173.5MM
24MM
516b
517b
90MM
32MM
27.5MM
515b
OPEN WIDTH 208MM
35.5MM
515a
90MM
43.5MM
39MM
516a
517a

Fig. 10


OPEN WIDTH 183.5MM
24MM
615b
100MM
32MM
27.5MM
616b
617b
100 MM FOLDED WIDTH
OPEN WIDTH 233MM
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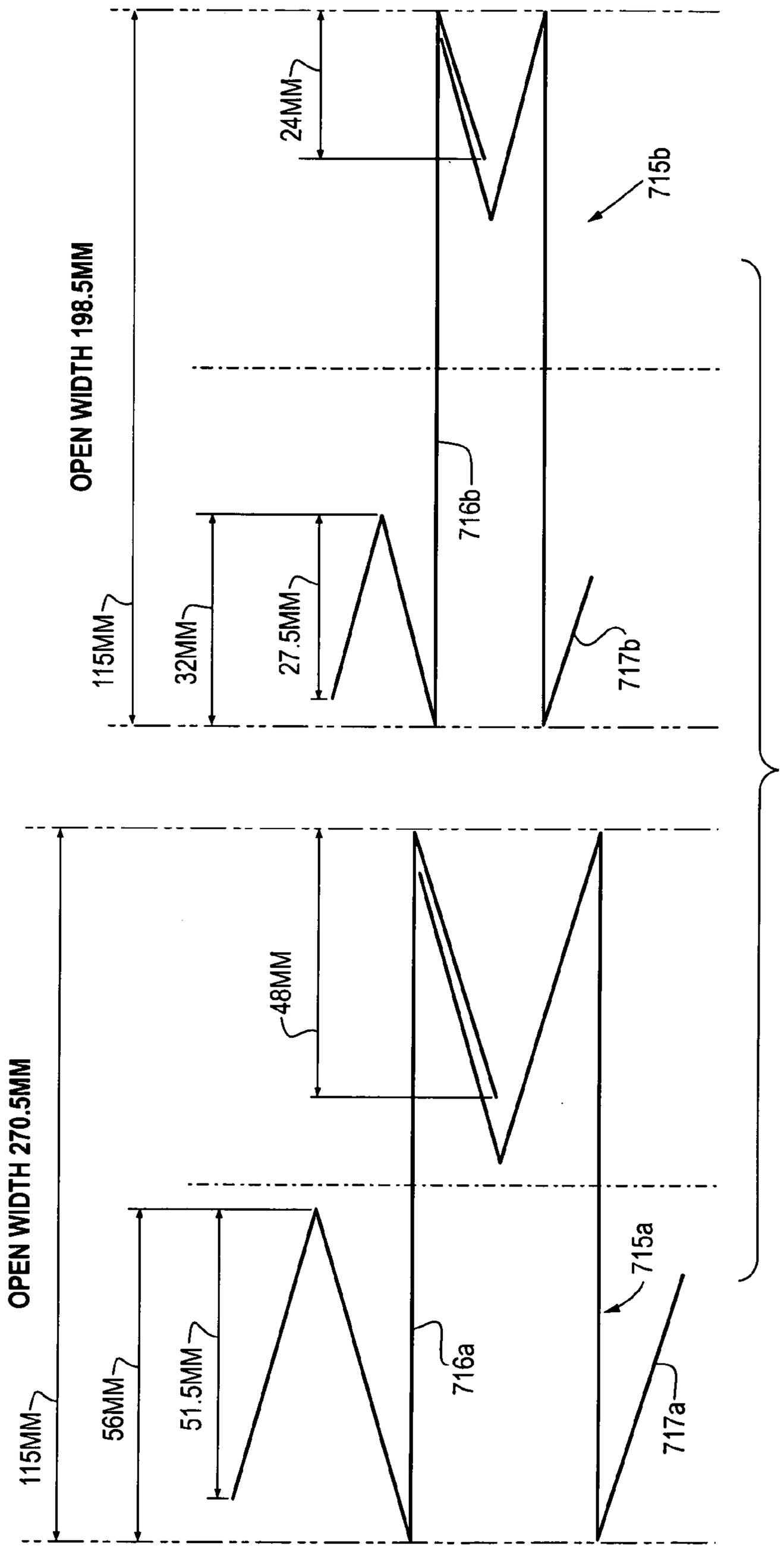
615a
100MM
48.5MM
44MM
616a
617a

Fig. 11


OPEN WIDTH 270.5MM
115MM FOLDED WIDTH
115MM
56MM
51.5MM
48MM
716a
715a
717a
OPEN WIDTH 198.5MM
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32MM
27.5MM
24MM
716b
715b
717b

Fig. 12

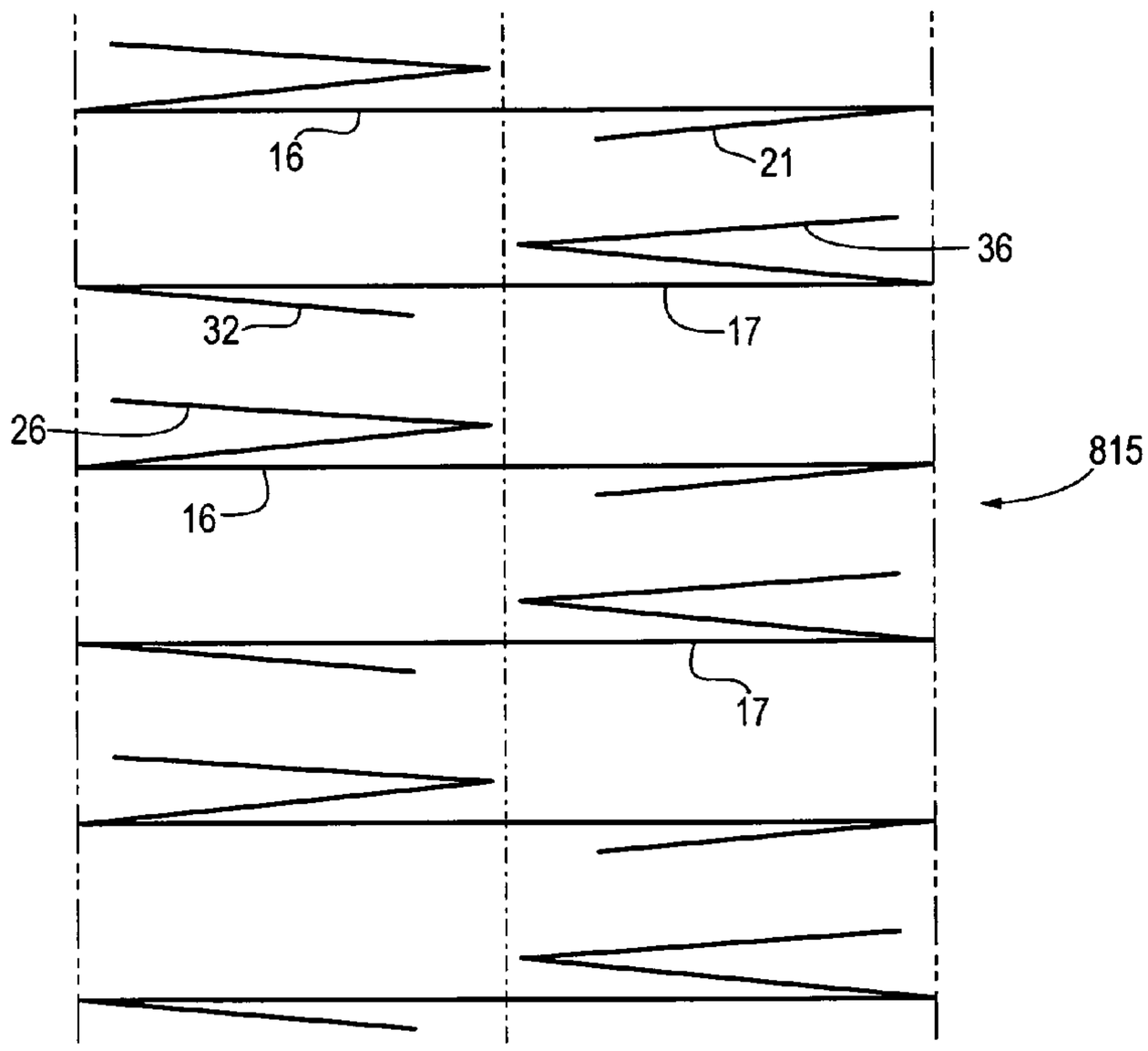
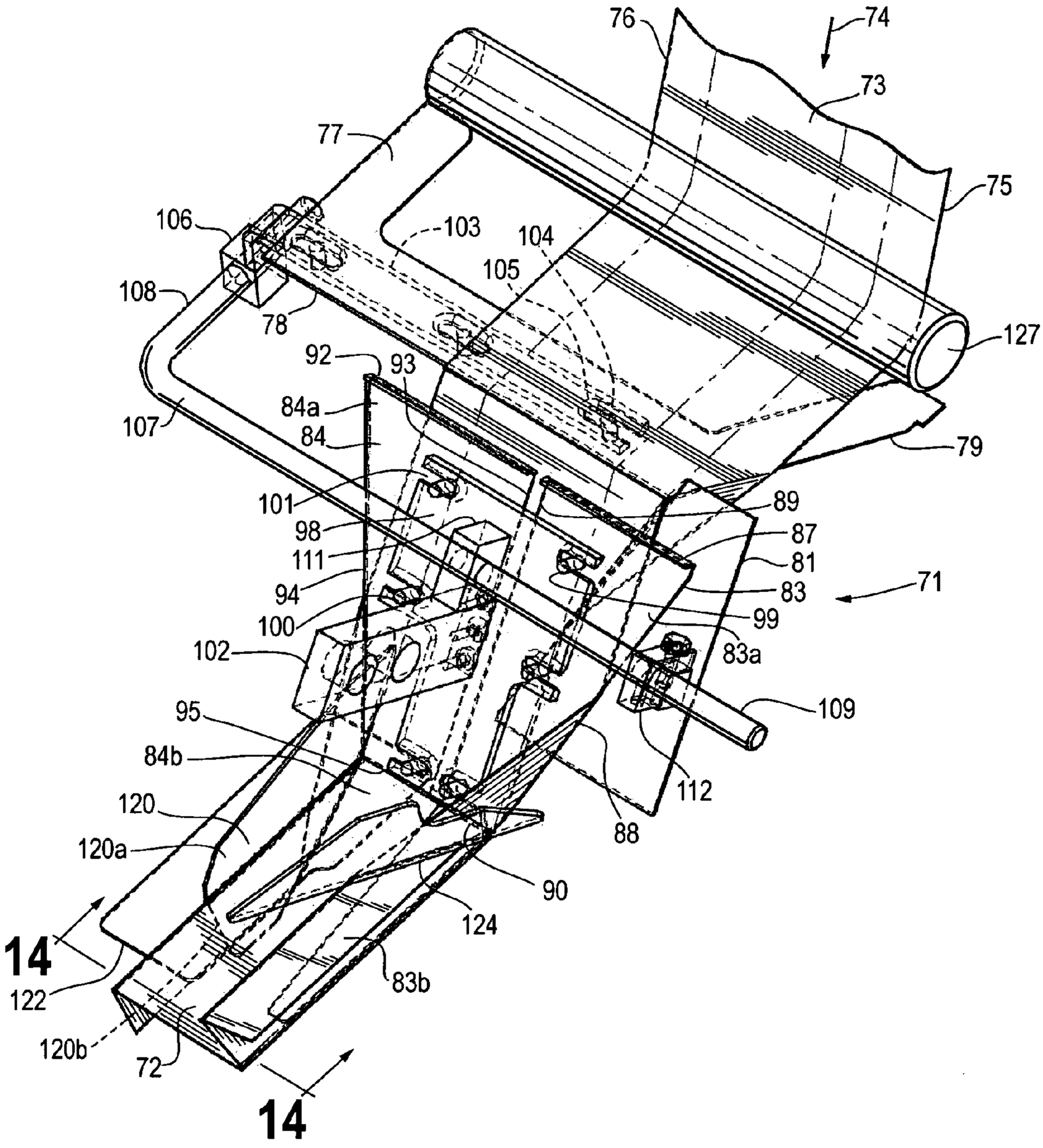


Fig. 13


76
74
73
77
75
106
103
104
105
108
78
127
92
93
84a
84
107
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101
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98
87
111
81
94
83
71
100
99
102
83a
109
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84b
112
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88
120a
90
124
14
83b
122
120b
72
14

Fig. 14

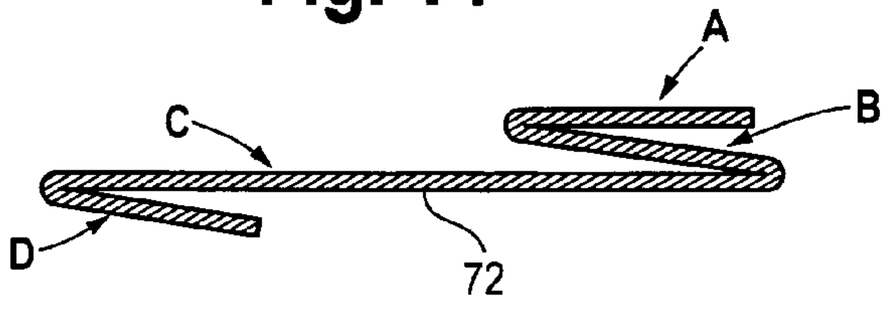

A
B
C
D
72

Fig. 15

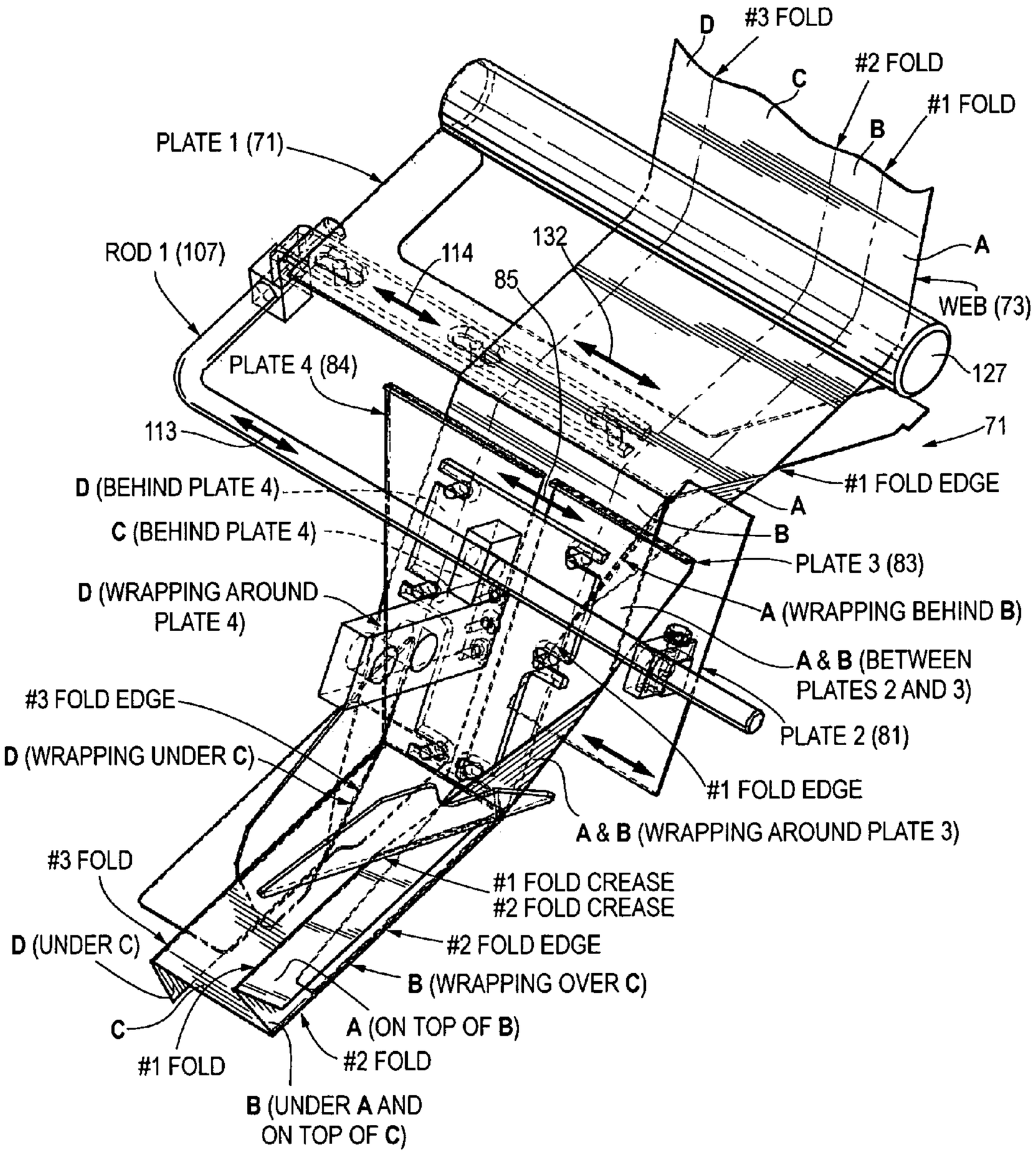

D
#3 FOLD
C
#2 FOLD
B
#1 FOLD
PLATE 1 (71)
ROD 1 (107)
114
132
85
A
WEB (73)
PLATE 4 (84)
127
113
71
D (BEHIND PLATE 4)
#1 FOLD EDGE
A
C (BEHIND PLATE 4)
B
PLATE 3 (83)
D (WRAPPING AROUND PLATE 4)
A (WRAPPING BEHIND B)
A & B (BETWEEN PLATES 2 AND 3)
#3 FOLD EDGE
PLATE 2 (81)
D (WRAPPING UNDER C)
#1 FOLD EDGE
A & B (WRAPPING AROUND PLATE 3)
#3 FOLD
#1 FOLD CREASE
#2 FOLD CREASE
D (UNDER C)
#2 FOLD EDGE
B (WRAPPING OVER C)
C
A (ON TOP OF B)
#1 FOLD
#2 FOLD
B (UNDER A AND ON TOP OF C)

Fig. 16

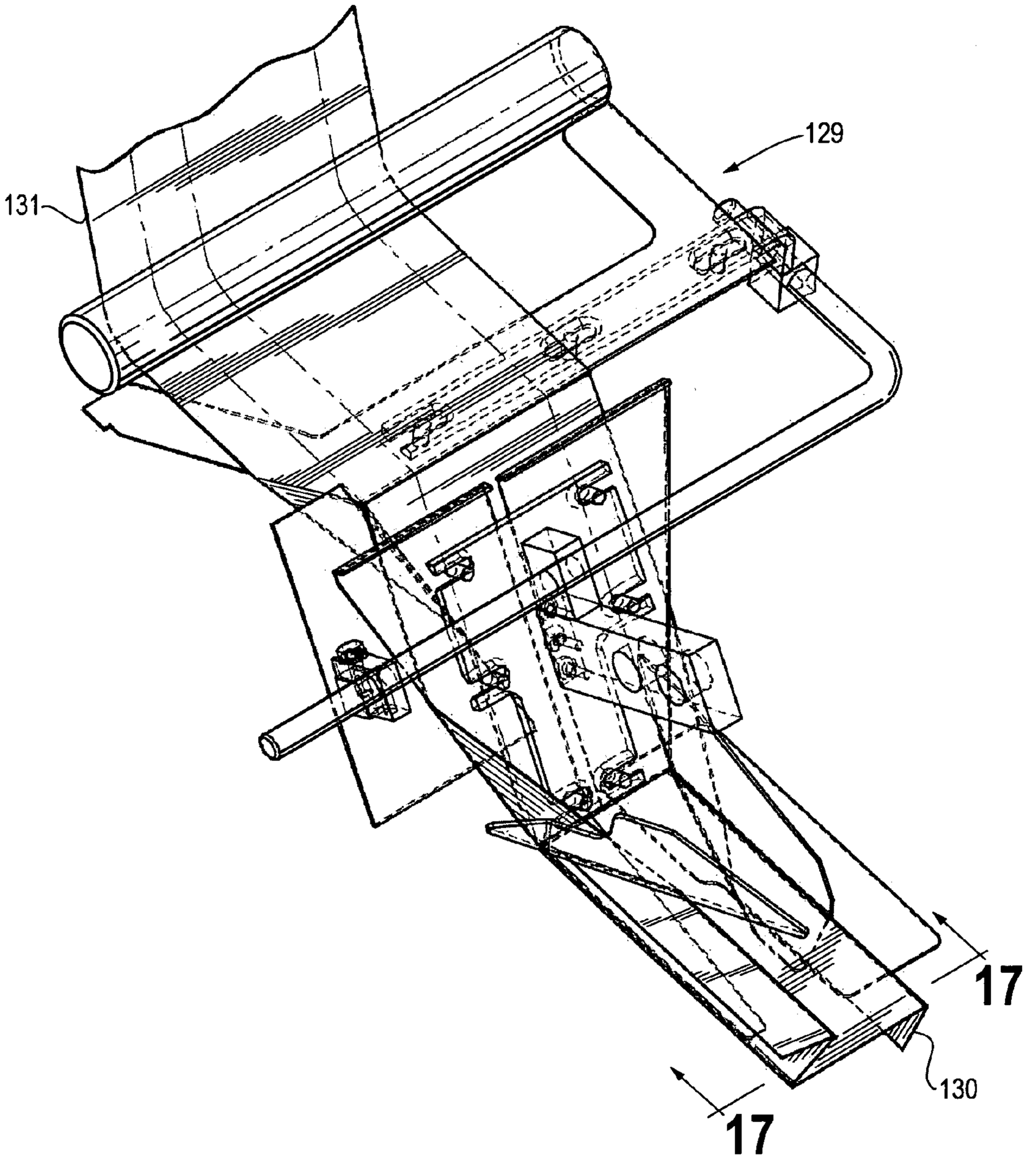


Fig. 17

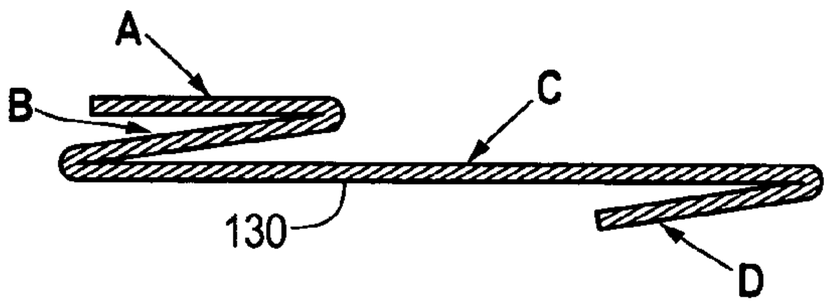
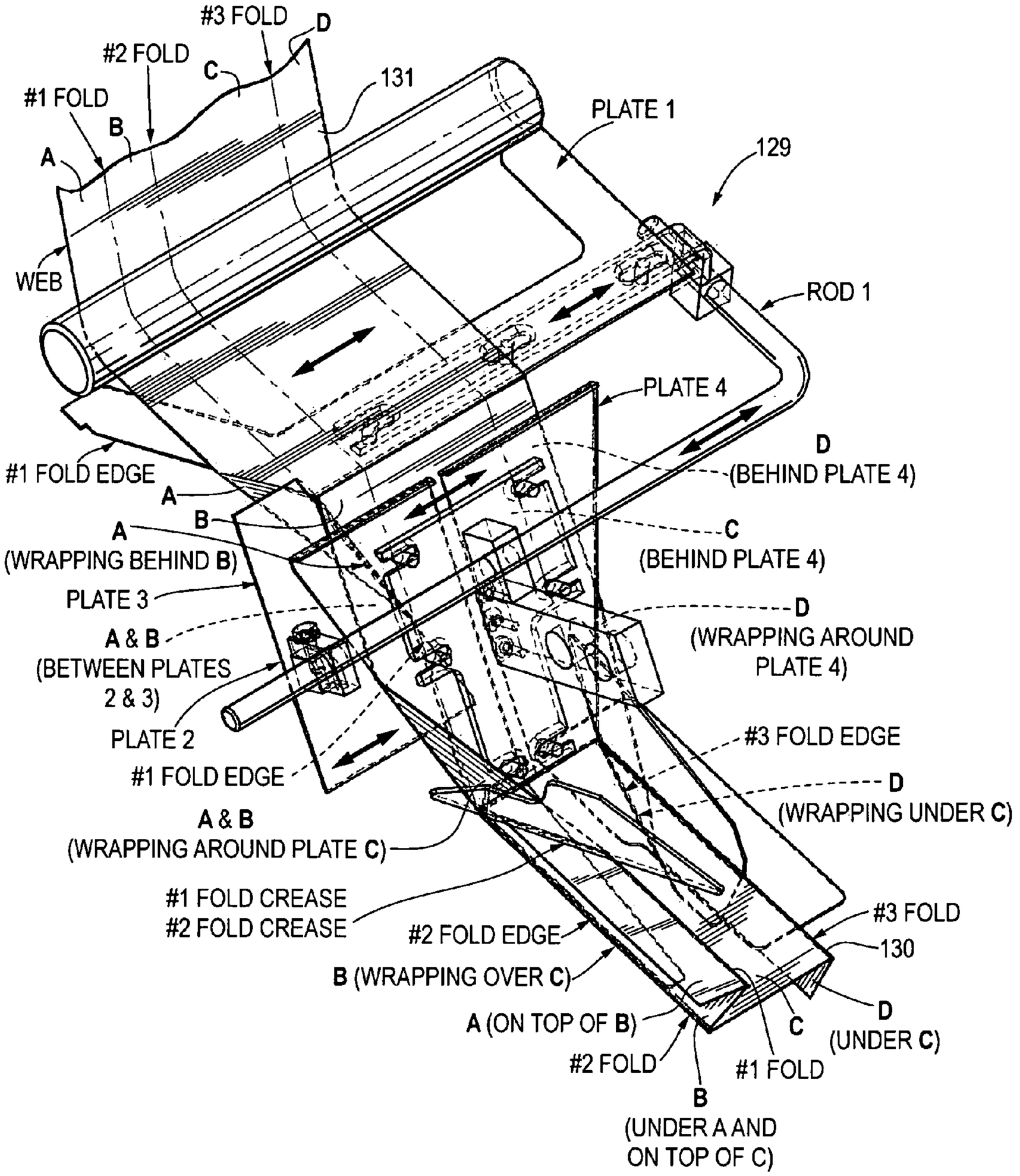


Fig. 18


#3 FOLD
D
#2 FOLD
C
#1 FOLD
B
A
131
PLATE 1
129
WEB
ROD 1
PLATE 4
#1 FOLD EDGE
A
B
A
(WRAPPING BEHIND B)
PLATE 3
A & B
(BETWEEN PLATES 2 & 3)
PLATE 2
#1 FOLD EDGE
A & B
(WRAPPING AROUND PLATE C)
#1 FOLD CREASE
#2 FOLD CREASE
D
(BEHIND PLATE 4)
C
(BEHIND PLATE 4)
D
(WRAPPING AROUND PLATE 4)
#3 FOLD EDGE
D
(WRAPPING UNDER C)
#3 FOLD
130
#2 FOLD EDGE
B (WRAPPING OVER C)
A (ON TOP OF B)
D
(UNDER C)
C
#2 FOLD
#1 FOLD
B
(UNDER A AND ON TOP OF C)

STACK COMPRISING MULTI-FOLDED FOUR PANEL SHEETS AND FOLDING BOARDS THEREFOR

BACKGROUND

This invention relates to folded sheets of paper tissue or similar material, which are sometimes called wipes. More specifically, the invention relates to a balanced stack of interfolded sheets wherein removal of the top sheet moves the next sheet into position for removal.

The final product is normally a stack of interfolded sheets that are stored in a container or dispenser which allows for a single sheet to be removed. The sheets are commonly constructed of materials such as papers, non-wovens, air laids, melt-blown, and spunlaced fabrics. The sheets can be either wet or dry.

Products that have narrower folded widths are commercially attractive due to shelf space limitations. However, narrow folded widths can be difficult to achieve with wide or medium width open sheets due to ply buildup in the stack. The ply buildup causes lumps in the stack that make it difficult to process and package the stack on automated equipment.

The prior art describes various types of folded sheets for forming stacks of sheets. For example, U.S. Pat. No. 3,207,360 describes a package of interleaved Z folded sheets.

U.S. Pat. No. 3,401,928 describes a stack of interleaved sheets in which each sheet includes two quarter folds on the top and a half-width fold on the bottom (FIG. **9**). Adjacent sheets are folded in opposite directions so that the stack is balanced. The patent also describes folding boards or plates for folding the sheets.

U.S. Pat. No. 4,138,034 describes a package of premoistened interleaved sheets. The sheets may have alternating V folds, or alternating Z folds.

U.S. Pat. No. 4,502,675 describes W folded sheets having four panels of equal width and also describes folding boards or plates.

U.S. Pat. No. 6,045,002 describes a stack of right and left V folded sheets which are alternately interleaved with right and left Z folded sheets and also describes folding boards or plates.

U.S. Pat. No. 6,168,848 describes a stack of interleaved W folded sheets and Z folded sheets.

U.S. Pat. No. 6,641,894 describes a stack of interleaved W folded sheets.

U.S. Pat. No. 6,740,021 describes folding boards for making V folded sheets.

U.S. Pat. No. 7,322,489 describes sheets which are Z folded, V folded, and C folded.

Despite the foregoing prior art, there is still a need in the wipes market for a stack of wide or medium width sheets or wipes which are folded down to a narrow folded width with no ply buildup across the width of the folded stack. For example, a common open width of sheet is 200 mm. The minimum stack width for a sheet of that width that is folded in accordance with the modified V fold of U.S. Pat. No. 5,497,903 is about 108 mm. The minimum stack width for a 200 mm sheet that is folded in accordance with the V-Z fold of U.S. Pat. No. 6,045,002 is about 109 mm. Ribbon weave and stacker tolerances could also add to the stack width. Many customers prefer a narrower stack width.

SUMMARY OF THE INVENTION

The invention provides a novel fold which enables a sheet of wide or medium width to be folded into a narrow stack width. The stack has consistent sheet location for ease of starter dispensing, symmetrical stack design allowing for top or bottom dispensing, and single sheet pull up tab, all without undesirable ply buildup in the folded stack.

For example, the inventive fold enables folding of a 200 mm wide sheet down to a stack width or folded width of about 87 mm. If desired, the 200 mm wide sheet can be folded to a folded width of greater than 87 mm.

The folded sheet includes four panels, including a center panel which defines the width of the stack. A second or bottom panel extends from one edge of the center panel below the center panel, and a V-folded top portion extends from the other edge of the center panel above the center panel and includes third and fourth panels. Alternatively, the second panel can extend above the center panel and the V-folded portion can extend below the center panel.

A stack is formed from two groups of sheets. The sheets of one group are the mirror images of the sheets of the other group. The sheets can be interleaved or not interleaved.

In the preferred embodiment, the inner edge of the second panel does not overlap the inner edge of the V-folded top portion and neither of the edges crosses over the center of the center panel. This provides the maximum width product with the most uniform layer concentration with no air gaps. However, in other embodiments the second panel and the inner edge of the V-fold cross the center of the center panel and overlap. As narrower products are run at the same stack width, the amount of overlap between the second panel and the V-folded portion can be reduced or the gap between the second panel and the V-folded portion can be widened.

The invention also provides novel adjustable folding boards or plates for forming the two groups of folded sheets. Each folding board includes movable plates which permit the width of each of the four panels of each sheet to be adjusted as desired.

DESCRIPTION OF THE DRAWING

The invention will be explained in conjunction with specific embodiments which are illustrated in the accompanying drawing, in which:

FIG. **1** is an end view of a partial stack of sheets which are folded in accordance with the invention;

FIG. **2** is a view similar to FIG. **1** with the folded sheets being of opposite hand to the sheets of FIG. **1**;

FIG. **3** illustrates the partial stack of FIG. **1** in an inverted position;

FIG. **4** illustrates the opposite hand partial stack of FIG. **2** in an inverted position;

FIGS. **5** through **7** illustrate partial stacks of sheets which are folded in accordance with the invention with different overlap conditions;

FIG. **8** illustrates a partial stack similar to FIG. **1** with various dimensions labeled;

FIGS. **9** through **11** illustrate how sheets of various widths can be folded in accordance with the invention to form relatively narrow stack widths;

FIG. **12** is a view of a partial stack similar to FIG. **1** in which the sheets are not interleaved;

FIG. **13** is a perspective view of a folding board for forming the right facing sheets of the previous figures;

FIG. **14** is a sectional view taken along the line **14-14** of FIG. **13**;

FIG. **15** is a view similar to FIG. **13** which is annotated to illustrate the folding edges and other parts of the folding board, web, and folded sheet;

FIG. **16** is a perspective view of a folding board for forming the left facing sheets of the previous figures;

FIG. **17** is a sectional view taken along the line **17-17** of FIG. **16**; and

FIG. **18** is a view similar to FIG. **16** which is annotated to illustrate the folding edges and other parts of the folding board, web, and folded sheet.

DESCRIPTION OF SPECIFIC EMBODIMENTS

Referring to FIG. **1**, a stack **15** of sheets is formed from two groups of folded sheets—left facing folded sheets **16** and right facing folded sheets **17**. Each left facing sheet **16** includes a center panel **18** having right and left edges **19** and **20** which define the width of the center panel, a second or bottom panel **21**, and a V-folded top portion **22** on the left side of the center panel. The second panel **21** extends below the center panel from the right edge **19** of the center panel and terminates in an inner edge **23**. The V-folded top portion **22** includes a third panel **24** which extends above the center panel from the left edge **20** of the center panel and terminates in an inner folded edge **25** and a fourth panel **26** which extends above the panel **24** from the edge **25** and terminates in an outer edge **27**.

Each right facing sheet **17** is the mirror image of the left facing sheets **16** and includes a center panel **28** having right and left edges **29** and **30**, a second or bottom panel **31** on the left side of the center panel, and a V-folded top portion **32** on the right side of the center panel. The second or bottom panel **31** extends below the center panel **28** from the left edge **30** of the center panel and terminates in an inner edge **33**. The V-folded top portion **32** includes a third panel **34** which extends above the center panel **28** from the right edge **29** of the center panel and terminates in a inner folded edge **35** and a fourth panel **36** which extends above the panel **34** from the edge **36** and terminates in an outer edge **37**.

The stack **15** shown in FIG. **1** is a partial stack which includes two left facing sheets **16** and two right facing sheets **17** which are alternately arranged in the stack. However, it will be understood that a stack will generally include a greater number of sheets **16** and **17** which are alternately arranged to form the stack.

In the embodiment illustrated in FIG. **1**, the alternating left and right sheets are interfolded or interleaved. The bottom panel **21** of each left facing sheet **16** underlies the fourth panel **36** of the adjacent lower right facing sheet **17**. The bottom panel **31** of each right facing sheet **17** underlies the fourth panel **26** of the adjacent lower left facing sheet. It will be understood that bottom panel of the last sheet of the stack is not interleaved since there is no sheet below that bottom panel.

When the stack is contained in a conventional container or package, the interleaving of the sheets assures that when the top sheet is removed from the container, the next sheet will "pop-up" or move into position for removal. The top panel **26** or **36** of the V-folded portion of the next sheet will advantageously be partially withdrawn through the opening of the container so that it can be easily grasped for later removal.

As will be explained hereinafter, the alternating sheets can also be placed on top of each other without interleaving.

Although each of the left and right sheets includes four panels, the inventive fold is different than prior W folds which included four equal width panels or two equal width center panels. The width of the center panels **18** and **28** defines the width of the stack, and the bottom panel and V-folded top panels of each sheet extend below and above, respectively, the center panel. The inventive fold can be described as a J-Z fold—the center panel (**18**, **28**), the bottom panel (**21**, **31**), and the lower half of the upper V-folded portion (**24**, **34**) form a Z fold, and the upper half of the V-folded portion (**26**, **36**) can be considered as generally J-shaped on top of the Z fold. The term "left facing sheet" with respect to the sheet **16** refers to the direction in which the J portion **26** extends or the direction in which the V-shaped portion **22** opens. Similarly, the term "right facing sheet" with respect to the sheet **17** refers to the direction in which the J portion **36** extends or the direction in which the V-shaped portion **32** opens.

In FIG. **1** the right and left edges of the center panels **18** and **28** are vertically aligned, and a center line CL bisects the center panels and the stack. In the preferred embodiment of FIG. **1**, the folded edges **25** and **35** of the V-folded portions **22** and **32** are spaced to the left and right, respectively, of the center line, i.e., the edges of the V-folds do not cross over the center of the stack and do not overlap. The space G between the edges **25** and **35** of the V-folds is referred to as the center fold gap. The width of the bottom panels **21** and **31** is slightly less than the width of the top panels **36** and **26**, respectively, so that the bottom panels can underlie the top panels without wrinkles. This configuration provides the maximum sheet width product with the most uniform layer concentration with no air gaps. As narrower sheet width products are run at the same stack width, the amount of overlap between the upper and lower sheets can be reduced and/or the center fold gap G between the V-folds can be widened.

FIGS. **5-7** illustrate alternate embodiments in which wider sheets are folded so that the folded edges of the V folds cross over the center line CL and overlap. In FIG. **5** left facing sheets **46** include a top V-folded portion **47** which includes a folded edge **48** which extends across the center line CL and a bottom panel **49** which terminates in an inner edge **50** which also extends across the center line. Right facing sheets **52** include a top V-folded portion **53** which includes a folded edge **54** which extends across the center line and a bottom panel **55** which terminates in an edge **56** which extends across the center line by slightly less than the extent of the folded edge **54**.

In FIG. **6**, the folded edges **60** and **61** of the left and right facing sheets extend even farther across the center line than in FIG. **5**, and the edges **62** and **63** of the bottom panels extend across the center line by slightly less than the extent of the folded edges **60** and **61**.

In FIG. **7** the folded edges **64** and **65** of the left and right facing sheets extend across the center line, but the edges **66** and **67** of the bottom panels do not extend across the center line.

FIG. **2** illustrates a stack **115** which is the same as the stack **15** of FIG. **1** but which is opposite hand to the stack of FIG. **1**. In other words, the top sheet **117** is a right facing sheet, and the next sheet **116** is a left facing sheet. The remaining sheets continue to alternate. The sheets of the stacks **15** and **115** are otherwise identical.

FIG. **3** illustrates a stack **215** which is the same as the stack **15** of FIG. **1** but which is inverted from the position of the stack **15**. The top sheet **216** is a left facing sheet with a center panel **218**, but the second panel **221** extends above the center panel, and the V-folded portion **222** with third and fourth panels **224** and **226** extends below the center panel. The second sheet **217** is a right facing sheet with a center panel **228**, a second panel **231** which extends above the center panel, and V-folded portion **232** with third and fourth panels **234** and **236** which extends below the center panel.

The alternating sheets **216** and **217** are interleaved. The second or top panel **231** of each right facing sheet **217** overlies the fourth panel **226** of each left facing sheet **216**, and the

second or top panel **221** of each left facing sheet **216** overlies the fourth panel **236** of each right facing sheet.

As with the stack **15** of FIG. **1**, when the inverted stack **215** is contained in a conventional container or package, the interleaving of the sheets assures that when the top sheet is removed from the container, the next sheet will "pop-up" or move into position for removal. The top panel **221** or **231** of the next sheet will advantageously be partially withdrawn through the opening of the container.

Either the upright stack **15** of FIG. **1** or the inverted stack **215** of FIG. **3** is also suitable for either top or bottom dispensing. When either stack is in a container, the sheets can be withdrawn from either the top or bottom of the container. When a sheet is withdrawn from the container, the interleaving of the sheets will cause the next sheet to be partially withdrawn.

FIG. **4** illustrates a stack **315** which is the same as the opposite hand stack **115** of FIG. **2** but which is inverted. The top sheet **317** is a right facing sheet, and the next sheet **316** is a left facing sheet.

FIG. **8** illustrates a stack **415** which is similar to the stack **15** of FIG. **1** and includes left facing sheets **416** and right facing sheets **417**. The dimension A is the distance or gap between the folded edges **425** and **435** of the V-folded portions **422** and **432**. In the preferred embodiments, the dimension A is a minimum of 3 mm.

The dimension B is the distance between the folded edge **435** or **425** of the V-folded portion **432** or **422** of one sheet and the inner edge **432** or **433** of the bottom panel of the other sheet. In the preferred embodiments, the recommended dimension B is 8 mm.

The dimension C is the distance between the outer edges **427** and **437** and the sides of the stack or the side edges of the center panels **418** and **428**. In the preferred embodiments, the recommended dimension C is 4.5 mm.

The dimension D is the amount of overlap between the interleaved bottom panels **421** and the top panels **436** and the interleaved bottom panels **431** and the top panels **426**. In the preferred embodiments, the recommended dimension D is a minimum of 19.5 mm. The amount of overlap to create good dispensing depends on variables such as the substrate or material of the sheets, the nature of any lotion or moistening material on the sheets, the size and shape of the opening in the container, etc. Such issues are generally decided by the manufacturer of the stack.

FIGS. **9-11** illustrate how sheets of various wide and medium widths can be folded into stacks having relatively narrow widths.

The stacks **515***a* and **515***b* of FIG. **9** are each 90 mm wide. The sheets **516***a* and **517***a* of stack **515***a* have an open width of 208 mm, and the sheets **516***b* and **517***b* of stack **515***b* have an open width of 173.5 mm. The dimensions of the various folded portions of the sheets are indicated.

The stacks **615***a* and **615***b* of FIG. **10** are each 100 mm wide. The sheets **616***a* and **617***a* of stack **615***a* have an open width of 233 mm, and the sheets **616***b* and **617***b* of stack **615***b* have an open width of 183.5 mm.

The stacks **715***a* and **715***b* of FIG. **11** are each 115 mm wide. The sheets **716***a* and **717***a* of stack **715***a* have an open width of 270.5 mm, and the sheets **716***b* and **717***b* of stack **715***b* have an open width of 193.5 mm.

In another embodiment, sheets having an open width of 10 inches were folded to a stack width of 4.25 inches.

FIG. **12** illustrates a stack **815** which is formed from left facing sheets **16** and right facing sheets **17** which are not interleaved or interfolded. The bottom panels **21** of each left facing sheet overlies the top panel **36** of the next right facing sheet, and the bottom panel **31** of each right facing sheet overlies the top panel **26** of the next left facing sheet. Removing the top sheet does not cause the next sheet to "pop-up."

The advantages of the inventive J-Z fold include:

- dispensing is better than The V-Z fold of U.S. Pat. No. 6,168,848 or the fold of U.S. Pat. No. 5,497,903 since all top sheets are of equal width (in the preferred embodiment);
- dispensing can be from either end of the stack for top or bottom dispensing;
- because dispensing can be from either end of the stack, the stack does not need to be turned over to feed into some flow wrappers or containers;
- the narrower folded width reduces packaging materials and provides a more attractive, less bulky package and narrower shelf space;
- the stack can have higher bulk; the sheet count of the stack can be reduced without affecting the height of the stack.

FIGS. **13-18** illustrate folding boards for forming the right and left facing folded sheets illustrated in the previous figures.

FIG. **13** illustrates a folding board **71** for forming a right facing folded sheet **72** from an elongated web **73** of appropriate material such as paper, non-woven, etc. The web is advanced in the direction of the arrow **74** and includes right and left side edges **75** and **76**.

FIG. **15** illustrates the same folding board, web, and folded sheet material with annotations for the various parts of the folding board, web, and sheet.

Referring to FIGS. **13** and **15**, the folding board **71** includes a horizontal first plate **77** (Plate **1**) which has a front edge **78** which extends transversely to the web and a right side edge **79** which extends angularly with respect to the right edge **76** of the web. A second plate **81** (Plate **2**) extends angularly downwardly from the first plate **77**. The first plate **77** and the second plate **81** are independently mounted on the frame of a conventional folding machine (not shown).

A third plate **83** (Plate **3**) and a fourth plate **84** (Plate **4**) are mounted in front of second plate **81** for sliding movement in the direction of arrow **85**. The third plate **83** includes a generally trapezoidally shaped portion **83***a* and a forwardly extending horizontal portion **83***b*. The trapezoidal portion **83***a* includes an upper edge **87** which extends transversely to the web, a right side edge **88** which extends angularly with respect to the right edge of the web, a left side edge **89** which extends parallel to the side edges of the web, and a bottom edge **90**.

The fourth plate **84** similarly includes a trapezoidal portion **84***a* and a forwardly extending horizontal bottom portion **84***b*. The trapezoidal portion includes an upper edge **92**, right and left side edges **93** and **94**, and bottom edge **95**.

The third and fourth plates **83** and **84** are slidably mounted on a mounting plate **98** by three pins **99** on plate **83** and three pins **100** on plate **84** and six slots **101** in the mounting plate **98**. The mounting plate **98** is secured to the frame of the folding machine by a mounting block **102** which is attached to the mounting plate.

The first plate **77** is supported on a support plate **103**, and the first plate **77** can move on the support plate **103** in a transverse direction relative to the web (cross machine direction) by means of bolts **104** on the first plate and slots **105** in the support plate **103**. Nuts (not shown) are threaded onto the bolts **104** for clamping the first plate **77** against the support plate **103**. The left end of the support plate **103** is supported by a mounting block **106**.

An L-shaped rod or link **107** includes a short leg **108** and a long leg **109**. The short leg **108** is attached to the left side of the first plate **77** and the support plate **103** by the mounting

block **106**. The long leg **109** of the rod is slidably supported by a block or bushing **111** which is attached to the fourth plate **85**. The end of the long leg **109** is attached to the second plate **81** by a mounting block **112**. The long leg **109** of the rod extends transversely to the web, and the long leg can be adjusted in the direction of the arrow **113** (cross machine direction) by sliding the long leg through the opening in the support block **111**. Adjusting the rod **107** will move the first plate **77** and the second plate **81** simultaneously.

An L-shaped left plow **120** includes a vertically extending portion **120***a* and a horizontally extending portion **120***b*. The plow **120** is supported at two points by the fourth plate **84** and by the mounting block **102**. The bottom portion **120***b* extends parallel to the bottom portion **84***b* of the fourth plate **84** and is spaced above the bottom portion **84***b*

A horizontal plate **122** extends parallel to the bottom portion **84***b* of the fourth plate **84** and to the bottom portion **120***b* of the plow **120** and is spaced below the bottom portion **84***b* of the fourth plate **84**. The plate **122** is supported by a bracket which is attached to the plow **120**.

A right plow **124** extends angularly with respect to the web and is spaced above the bottom portion **83***b* of the third plate **83**. The plow **124** is supported by a shaft which is connected to the mounting block **102**.

FIG. **14** is a sectional view of the right facing folded web **72** which is formed by the folding board **71**. The right facing folded web includes four panels A, B, C, and D. After the web is folded, it is interleaved with one or two left facing folded webs in a manner well known to those skilled in the art, and a plurality of interleaved webs are cut to form a stack of folded sheets.

A turning bar **127** is mounted on the folding machine above the first plate **77**. The web **73** is fed under the turning bar and over the front edge **78** and right side edge **79** of the first plate **77**. Referring to the upper right portion of FIG. **15**, the portions of the web which will be folded to form the four panels A, B, C, and D are indicated. The three fold lines along which the web will be folded to form the four panels are indicated as #1 fold, #2 fold, and #3 fold. The central panel C of the web is not folded by the folding board.

As the web advances over the front edge **78** and the right side edge **79** of the first plate **77**, the right side of the web is folded downwardly by the right side edge **79** to form panel A. The web is then advanced between the second plate **81**, which completes the fold of panel A, and the third and fourth plates **83** and **84**. The once-folded right portion of the web is folded again as it advances over the angular right edge **88** of the third plate **83** to form the panel B, and the panels A and B are positioned above the central panel C. The panels A and B and the adjacent portion of the central panel C are advanced above the bottom portion **83***b* of the third plate **83** and below the bottom edge of the right plow **124**. The right plow creases the #1 and #2 fold lines which form panels A and B.

As the left edge of the web is advanced over the angular left side edge **94** of the fourth plate **84**, the left side of the web is folded by the side edge **94** and panel D is formed. Panel D and the adjacent portion of the central panel C are advanced above the bottom portion **120***b* of the left plow **120**.

FIGS. **16** and **18** illustrate a folding board **129** for forming a left facing folded sheet **130** from a web **131**. The folding board **129** is the mirror image of the folding board **71** and operates in the same way.

The folding boards **71** and **129** facilitate adjustments to the widths of the four panels A, B, C, and D of the folded sheets. Referring to FIG. **15**, shifting the web **73** transversely either right or left in the direction of arrow **132** (cross machine direction) will change the widths of panels A and D relative to each other.

Adjusting the first plate **77** and the second plate **81** relative to the web by moving the rod **107** in the direction of arrow **113** will change the width of panel A.

The first plate **77** can be adjusted relative to the second plate **81** by loosening the nuts on bolts **104** and sliding the first plate **77** over the support plate **103** in the direction of arrow **114**.

Adjusting the third plate **83** relative to the web by moving the third plate in the direction of the arrow **85** will change the widths of panels B and C. Similarly, adjusting the fourth plate **84** in the direction of the arrow **85** will change the widths of panels D and C.

The adjustable folding boards also permit adjustments to achieve consistency of the final product if the web stretches during processing by the folding machine.

While in the foregoing specification a detailed description of specific embodiments was set forth for the purpose of illustration, it will be understood that many of the details described herein can be varied considerably by those skilled in the art without departing from the spirit and scope of the invention.

I claim:

1. A stack of folded sheets comprising first and second groups of folded sheets,

each of the sheets of the first group including a center panel having right and left outer edges which define the width of the center panel, a second panel which extends inwardly from the right edge of the center panel and terminates in a left inner edge, and a V-shaped portion extending from the left edge of the center panel and including third and fourth panels, the third panel extending inwardly from the left edge of the center panel and terminating in a right inner edge, the fourth panel extending outwardly from the right edge of the third panel and terminating in a left outer edge, each of the second, third, and fourth panels having a width less than the width of the center panel,

each of the sheets of the second group including a center panel having right and left outer edges which define the width of the center panel, a second panel which extends inwardly from the left edge of the center panel and terminates in a right inner edge, and a V-shaped portion extending from the right edge of the center panel and including third and fourth panels, the third panel extending inwardly from the right edge of the center panel and terminating in a left inner edge, the fourth panel extending outwardly form the left edge of the third panel and terminating in a right outer edge, each of the second, third, and fourth panels having a width less than the width of the center panel,

said sheets being arranged so that the second panel of each sheet of each group except the bottom sheet of the stack is adjacent a fourth panel of a sheet of the other group.

2. The stack of claim **1** in which the center panels of the first and second groups overlie each other with the right and left edges thereof generally aligned, the width of the center panels defining the width of the stack.

3. The stack of claim **1** in which the second panel of each sheet of each group except the bottom sheet of the stack is interleaved with a fourth panel of a sheet of the other group.

4. The stack of claim **1** in which the second panel of each sheet extends below the center panel of the sheet and the V-shaped portion of each sheet extends above the center panel of the sheet.

5. The stack of claim 1 in which the second panel of each sheet extends above the center panel of the sheet and the V-shaped portion of each sheet extends below the center panel of the sheet.

6. The stack of claim 1 in which the width of each of the second, third, and fourth panels of each sheet is less than half of the width of the center panel of the sheet.

7. The stack of claim 1 in which the inner edge of the second panel of each sheet does not overlap the inner edge of said third panel of the sheet.

8. The stack of claim 1 in which the width of the second panel of each sheet does not exceed the widths of the third and fourth panels of the sheet.

9. A stack of folded sheets comprising first and second groups of folded sheets,

each of the sheets of the first group including a center panel having right and left outer edges, a second panel which extends inwardly from the right edge of the center panel and terminates in a left inner edge, and a V-shaped portion extending from the left edge of the center panel and including third and fourth panels, the third panel extending inwardly from the left edge of the center panel and terminating in a right inner edge, the fourth panel extending outwardly from the right edge of the third panel and terminating in a left outer edge,

each of the sheets of the second group including a center panel having right and left outer edges, a second panel which extends inwardly from the left edge of the center panel and terminates in a right inner edge, and a V-shaped portion extending from the right edge of the center panel and including third and fourth panels, the third panel extending inwardly from the right edge of the center panel and terminating in a left inner edge, the fourth panel extending outwardly form the left edge of the third panel and terminating in a right outer edge,

said sheets being arranged so that the second panel of each sheet of each group except the bottom sheet of the stack is adjacent a fourth panel of a sheet of the other group,

the second panel of each sheet of each group except the bottom sheet of the stack being interleaved with a fourth panel of a sheet of the other group, the inner edge of the second panel of each sheet not overlapping the inner edge of said third panel of the sheet.

10. A stack of folded sheets comprising first and second groups of folded sheets,

each of the sheets of the first group including a center panel having right and left outer edges, a second panel which extends inwardly from the right edge of the center panel and terminates in a left inner edge, and a V-shaped portion extending from the left edge of the center panel and including third and fourth panels, the third panel extending inwardly from the left edge of the center panel and terminating in a right inner edge, the fourth panel extending outwardly from the right edge of the third panel and terminating in a left outer edge,

each of the sheets of the second group including a center panel having right and left outer edges, a second panel which extends inwardly from the left edge of the center panel and terminates in a right inner edge, and a V-shaped portion extending from the right edge of the center panel and including third and fourth panels, the third panel extending inwardly from the right edge of the center panel and terminating in a left inner edge, the fourth panel extending outwardly form the left edge of the third panel and terminating in a right outer edge,

said sheets being arranged so that the second panel of each sheet of each group except the bottom sheet of the stack is adjacent a fourth panel of a sheet of the other group,

the second panel of each sheet of each group except the bottom sheet of the stack being interleaved with a fourth panel of a sheet of the other group, the width of each of the second panels not exceeding the widths of each of the third and fourth panels.

11. A stack of folded sheets comprising first and second groups of folded sheets,

each of the sheets of the first group including a center panel having right and left outer edges which define the width of the center panel, a second panel which extends inwardly from the right edge of the center panel and terminates in a left inner edge, and a V-shaped portion extending from the left edge of the center panel and including third and fourth panels, the third panel extending inwardly from the left edge of the center panel and terminating in a right inner edge, the fourth panel extending outwardly from the right edge of the third panel and terminating in a left outer edge, each of the second, third, and fourth panels having a width less than the width of the center panel,

each of the sheets of the second group including a center panel having right and left outer edges which define the width of the center panel, a second panel which extends inwardly from the left edge of the center panel and terminates in a right inner edge, and a V-shaped portion extending from the right edge of the center panel and including third and fourth panels, the third panel extending inwardly from the right edge of the center panel and terminating in a left inner edge, the fourth panel extending outwardly form the left edge of the third panel and terminating in a right outer edge, each of the second, third, and fourth panels having a width less than the width of the center panel,

said sheets being arranged so that the fourth panel of each sheet of each group except the bottom sheet of the stack is adjacent a second panel of a sheet of the other group.

12. The stack of claim 11 in which the center panels of the first and second groups overlie each other with the right and left edges thereof generally aligned, the width of the center panels defining the width of the stack.

13. The stack of claim 11 in which the second panel of each sheet of each group except the bottom sheet of the stack is interleaved with a fourth panel of a sheet of the other group.

14. The stack of claim 11 in which the second panel of each sheet extends above the center panel of the sheet and the V-shaped portion of each sheet extends below the center panel of the sheet.

15. The stack of claim 11 in which the width of each of the second, third, and fourth panels of each sheet is less than half of the width of the center panel of the sheet.

16. The stack of claim 11 in which the inner edge of the second panel of each sheet does not overlap the inner edge of said third panel of the sheet.

17. The stack of claim 11 in which the width of the second panel of each sheet does not exceed the widths of the third and fourth panels of the sheet.

18. A stack of folded sheets comprising first and second groups of folded sheets,

each of the sheets of the first group including a center panel having right and left outer edges, a second panel which extends inwardly from the right edge of the center panel and terminates in a left inner edge, and a V-shaped portion extending from the left edge of the center panel and including third and fourth panels, the third panel extend-

ing inwardly from the left edge of the center panel and terminating in a right inner edge, the fourth panel extending outwardly from the right edge of the third panel and terminating in a left outer edge,

each of the sheets of the second group including a center panel having right and left outer edges, a second panel which extends inwardly from the left edge of the center panel and terminates in a right inner edge, and a V-shaped portion extending from the right edge of the center panel and including third and fourth panels, the third panel extending inwardly from the right edge of the center panel and terminating in a left inner edge, the fourth panel extending outwardly form the left edge of the third panel and terminating in a right outer edge,

said sheets being arranged so that the fourth panel of each sheet of each group except the bottom sheet of the stack is adjacent a second panel of a sheet of the other group,

the second panel of each sheet of each group except the bottom sheet of the stack being interleaved with a fourth panel of a sheet of the other group,

the inner edge of the second panel of each sheet not overlapping the inner edge of said third panel of the sheet.

19. A stack of folded sheets comprising first and second groups of folded sheets,

each of the sheets of the first group including a center panel having right and left outer edges, a second panel which extends inwardly from the right edge of the center panel and terminates in a left inner edge, and a V-shaped portion extending from the left edge of the center panel and including third and fourth panels, the third panel extending inwardly from the left edge of the center panel and terminating in a right inner edge, the fourth panel extending outwardly from the right edge of the third panel and terminating in a left outer edge,

each of the sheets of the second group including a center panel having right and left outer edges, a second panel which extends inwardly from the left edge of the center panel and terminates in a right inner edge, and a V-shaped portion extending from the right edge of the center panel and including third and fourth panels, the third panel extending inwardly from the right edge of the center panel and terminating in a left inner edge, the fourth panel extending outwardly form the left edge of the third panel and terminating in a right outer edge,

said sheets being arranged so that the fourth panel of each sheet of each group except the bottom sheet of the stack is adjacent a second panel of a sheet of the other group,

the second panel of each sheet of each group except the bottom sheet of the stack being interleaved with a fourth panel of a sheet of the other group, the width of each of the second panels not exceeding the widths of each of the third and fourth panels.

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